XXIII.

ON THE CONDITIONS THAT DETERMINE THE LENGTH OF THE SPECTRUM.

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Professor Langley's conclusion as to the absence in the sun's rays of wave lengths as long as those to be found in the moon's rays has been a surprise to many, who for theoretical reasons have thought it to be wellnigh certain that all possible wave lengths were to be found in the sun's rays.

The common implication is that, when a body is being heated, the shorter wave lengths that appear are simply added to those already present, so that the spectrum's length is in a manner proportional to the temperature of the radiating body. If that was so it is difficult to see how there could be economy in electric glow lamps by simply using higher potential. It might give more light, but if at the same time the lower so-called heat-waves were just as numerous and with greater amplitude, that is, if the visible waves were not in any way the representatives of the energy of the lower end of the spectrum, then the amount of light would be proportional to the amount of energy expended, which is not the case.

Instead of that it increases as the 3d power. This great increase of the visible waves is then at the expense of the lower end of the spectrum, and any measure of the length of the spectrum from such a source would probably show a marked decrease in the length of it between a low red and a white heat. This, too, is in accordance with molecular dynamics. If there be a gaseous volume of elastic molecules at any assigned temperature, the molecules collide and vibrate between impacts. Their rates of vibration must depend upon their molecular weight and elasticity, and similar molecules vibrate at equal rates. The characteristic wave lengths, or those by which a given gas may be identified, are produced by the vibrations between impacts, and the number of impacts per second will depend upon the gaseous density.

Suppose a body capable of vibrating a times per second for its fundamental be struck b times per second; then will its rate of vibrating be interfered with $\frac{a}{b}$ times. If b be less than a, then will there be a certain number of these vibrations made per second. If b be equal to a, then after the first impact the body will vibrate in its own period with increasing amplitude and without interference. If b be greater than a, then will interferences take place in all phases of the vibrations, and the body will not make any characteristic vibrations. That is, its fundamental rate will be destroyed. If the body can vibrate in any harmonic series, some of these harmonics might be present associated with such irregular forced vibrations above its fundamental number, and a spectrum of such a body would consist of such shorter waves. It would apparently be moved towards the blue end. If then the light-giving molecules of the sun have either so short a free path, or the velocity between impacts is so great, as to insure that the number of impacts per second is comparable with the vibrating rate of the molecules, one ought to expect that the fundamentals would largely be destroyed, and therefore could have no representations in the spectrum, while a colder body like the moon, with a vastly less molecular velocity, might have an appreciably longer spectrum.